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MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

**FOURTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION - April/May 2017**

**SUBJECT: DIGITAL SIGNAL PROCESSING (ECE - 2203)**

**TIME: 3 HOURS** **MAX. MARKS: 50**

**Instructions to candidates**

- Answer **ALL** questions.
- Missing data may be suitably assumed.

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| 1A. | The signal $0.7^n u[n]$ is applied to the input of an unknown causal LTI system and $0.7^n u[n] + 0.5^n u[n]$ is observed at the output. Identify the causal input signal that will cause the output $0.5^n u[n]$. Evaluate the system function and impulse response of the system | |
| 1B. | Explain overlap save method of filtering long length data sequence. | |
| 1C. | Consider a linear shift invariant discrete system with input $x[n]$ and output $y[n]$ for which $y[n] - y[n-1] - \frac{1}{4}y[n-2] = 3x[n] - 2x[n-1]$. Determine the system function and comment on causality and stability. | |
| | | **(5+3+2)** |
| 2A. | Compute 8-point DFT of the sequence $x[n] = \cos\left[\frac{\pi}{2}n\right], 0 \le n \le 7$ using radix-2 DIT - FFT algorithm. Specify the computational advantages of FFT when compared with direct DFT in terms of complex multiplications and additions. | |
| 2B. | Compute 8 point DFT of $x(n) = 3 - \lvert n \rvert; -2 \le n \le 2$. Plot the magnitude and phase spectrum. | |
| 2C. | X[k]= [ 4, 1-j2.4, 0, 1-j0.4, 0, 1+j0.4, 0, 1+j2.4] is eight point DFT of $x[n] = \begin{cases} 1, 0 \le n \le 3 \\ 0, elsewhere \end{cases}$<br>Compute 8 point DFT of $x_1[n] = \begin{cases} 0, & 0 \le n \le 3 \\ 1, & 4 \le n \le 7 \end{cases}$ | |
| | | **(5+3+2)** |
| 3A. | Determine the coefficients of a linear phase FIR filter of length M=15 which has symmetric unit sample response and a frequency response that satisfies the conditions<br>$H_r\left(\frac{2\pi k}{15}\right) = \begin{cases} 1, & k = 0,1,2,3 \\ 0.4, & k = 4 \\ 0, & k = 5,6,7 \end{cases}$ | |
| 3B. | Consider a 5 length Linear phase FIR filter(symmetric impulse response) with one of the zeros located at $Z_1$=0.25j. Find the location of other zeros and plot them in Z plane. Also determine the system function. | |
| 3C. | Write the expression for Hamming and Hanning window function. | |
| | | **(5+3+2)** |

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| 4A. | Explain the properties of Chebyshev type-I filter. Discuss with mathematical expressions about pole location and estimation of order for low pass filter | |
| 4B. | Explain the analog to digital mapping principle in bilinear transformation method. What is frequency warping and how it is compensated?. | |
| 4C. | Write the time domain and frequency domain constraints for FIR filters to have linear phase response. | |
| | | **(5+3+2)** |
| 5A. | Determine the impulse response of an FIR lattice with parameters $K_1$ =0.6, $K_2$=0.4, $K_3$=0.8. Also sketch the lattice and direct form structures. | |
| 5B. | Explain the spectral leakage and resolution problems involved in estimation of PSD | |
| 5C. | What are the limitations of non-parametric methods in spectral estimation. | |
| | | **(5+3+2)** |